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Coal Combustion Waste Impoundment

Dam Assessment Report

Mayo Ash Pond
Progress Energy
Roxboro, North Carolina

Project # 0-381

Assessment of Dam Safety
Coal Combustion Surface Impoundments
for the REAC Program

Prepared for:

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for
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Cincinnati, Ohio

Prepared by:

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Under Contract Number: EP-C-04-032: REAC

June 2009

INTRODUCTION

The release of over 5 million cubic yards of coal ash from the Tennessee Valley Authority's Kingston, Tennessee, facility in December 2008 serves as an important reminder of the need for our continued diligence on disposal units where coal combustion wastes are managed. The coal ash from the facility flooded more than 300 acres of land, damaging homes and property. It is critical that we all work to the best of our abilities to prevent a similar catastrophic failure and resultant environmental damage. One of the first steps in this effort is to assess the stability of the impoundments and similar units that contain coal combustion residuals and by-products to determine if and where corrective measures may be needed and then to carry out those measures as expeditiously as possible.

This report for the Progress Energy Carolina Mayo facility assesses the stability of the subject management units. This evaluation is based on a site assessment conducted on Friday, June 3, 2009 by Dewberry & Davis, Inc.

PURPOSE AND SCOPE

The U.S. Environmental Protection Agency (EPA) is embarking on an initiative to investigate the potential for catastrophic failure of Coal Combustion Surface Impoundments (i.e., management unit) from occurring at electric utilities in an effort to protect lives and property from the consequences of a dam failure or the improper release of impounded slurry. The EPA initiative is intended to identify conditions that may adversely affect the structural stability and functionality of a management unit and its appurtenant structures (if present); to note the extent of deterioration (if present), status of maintenance and/or a need for immediate repair; to evaluate conformity with current design and construction practices; and to determine the hazard potential classification for units not currently classified by the management unit owner or by a state or federal agency. The initiative will address management units that are classified as having a Less-than-Low, Low, Significant or High Hazard Potential ranking. (For Classification, see pp. 3-8 of the 2004 Federal Guidelines for Dam Safety)

In February 2009, the EPA sent letters to coal-fired electric utilities seeking information on the safety of surface impoundments and similar facilities that receive liquid-borne material that store or dispose of coal combustion residue. This letter was issued under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 104(e), to assist the Agency in assessing the structural stability of such management units, including which facilities should be visited to perform a safety assessment of the berms, dikes, and dams used in the construction of these impoundments.

EPA requested that utility companies identify all management units including surface impoundments or similar diked or bermed management units or management units designated as landfills that receive liquid-borne material used for the storage or disposal of residuals or by-products from the combustion of coal, including, but not limited to, fly ash, bottom ash, boiler slag, or flue gas emission control residuals. Utility companies provided information on the size, design, age and the amount of material placed in the units. The EPA used the information received from the utilities to determine preliminarily which management units had or potentially could have High Hazard Potential ranking.

DRAFT

The purpose of this report is to evaluate the condition and potential of waste release from the selected High Hazard Potential management units. This evaluation included a site visit. Prior to conducting the site visit, a two-person team reviewed the information submitted to EPA, reviewed any relevant publicly available information from state or federal agencies regarding the unit hazard potential classification (if any) and accepted information provided via telephone communication with the management unit owner.

EPA sent two engineers, one of whom was a professional engineer (PE), for a one-day site visit. The two-person team met with the owner of the management unit to discuss the engineering characteristics of the unit as part of the site visit. During the site visit, the team collected additional information about the management unit to be used in determining the hazard potential classification of the management unit(s).

Factors considered in determining the hazard potential classification of the management units(s) included the age and size of the impoundment, the quantity of coal combustion residuals or by-products that were stored or disposed of in these impoundments, its past operating history, and its geographic location relative to down gradient population centers and/or sensitive environmental systems.

This report presents the opinion of the assessment team as to the potential of catastrophic failure and reports on the condition of the management unit(s). The team considered criteria in evaluating dams under the National Inventory of Dams, in making these determinations.

LIMITATIONS

The assessment of dam safety reported herein is based on field observations and review of readily available information provided by the owner/operator of the subject coal combustion waste management unit(s). Qualified Dewberry engineering personnel performed the field observations and review and made the assessment in conformance with the required scope of work and in accordance with reasonable and acceptable engineering practices. No other warranty, either written or implied, is made with regard to our assessment of dam safety.

DRAFT

TABLE OF CONTENTS

APPENDICES

APPENDIX A – REFERENCE DOCUMENTS

Doc 1: Independent Consultant Inspection
Doc 2: PEC Exhibits
Doc 3: Emergency Action Plan
Doc 4: Progress Energy Questionnaire
Doc 5: Semi-Annual Report (February 12, 2009)
Doc 6: Annual Report (March 6, 2008)
Doc 7: 5 Year Report (June 9, 2004)
Doc 8: Geological Summary
Doc 9: Dam Photo Log
Doc 10: Aerial Photography

APPENDIX B – PHOTOGRAPHS

Photo 1: Upstream Embankment, Crest, Photo: 042, 6/3/09
Photo 2: Crest Looking Northwest, Crest, Photo: 041, 6/3/09
Photo 3: Bare Areas and Straw Build Up, Downstream Embankment, Photo: 004, 6/3/09
Photo 4: Mowing Equipment Rutting, Downstream Embankment, Photo: 007, 6/3/09
Photo 5: Embankment Looking to Right Abutment, Downstream Embankment, Photo: 036, 6/3/09
Photo 6: Outfall to Stream Over Weir, Outfall, Photo: 072, 6/3/09
Photo 7: Internal Drain Outlet, Toe, Photo: 019, 6/3/09
Photo 8: Primary Outlet, Outfall, Photo: 079, 6/3/09
Photo 9: View of Left Groin and Embankment, Left Groin, Photo: 032, 6/3/09
Photo 10: View of Ash Pond and Upstream Slope, Near Primary Outlet, Photo: 075, 6/3/09

APPENDIX C – FIELD OBSERVATION CHECKLIST

Doc 1: Coal Combustion Dam Inspection Checklist Form

1.0 CONCLUSIONS AND RECOMMENDATIONS

1.1 CONCLUSIONS

Conclusions are based on visual observations from our one-day site visit and review of technical documentation provided by Progress Energy.

1.1.1 Conclusions Regarding the Structural Soundness of the Management Unit(s)

The embankment and spillway appear to be structurally sound.

1.1.2 Conclusions Regarding the Hydrologic/Hydraulic Safety of the Management Unit(s)

Adequate freeboard and capacity exist to safely pass the design storm.

1.1.3 Conclusions Regarding the Adequacy of Supporting Technical Documentation

Supporting technical documentation is adequate.

1.1.4 Conclusions Regarding the Description of the Management Unit(s)

The descriptions provided are appropriate.

1.1.5 Conclusions Regarding the Field Observations

Embankments visually appear to be well maintained, safe, and structurally sound. There are no apparent indications of any unsafe conditions.

1.1.6 Conclusions Regarding the Adequacy of Maintenance and Methods of Operation

Maintenance and methods of operation are adequate.

1.1.7 Conclusions Regarding the Adequacy of the Surveillance and Monitoring Program

Surveillance and monitoring program are adequate.

1.1.8 Classification Regarding Suitability for Continued Safe and Reliable Operation

Facility is SATISFATORY for continued safe and reliable operation. No existing or potential management unit safety deficiencies are recognized. Acceptable performance is expected under all applicable loading conditions (static, hydrologic, seismic) in accordance with the applicable criteria.

1.2 RECOMMENDATIONS

1.2.1 Recommendations Regarding the Structural Stability

None appear warranted at this time.

1.2.2 Recommendations Regarding the Hydrologic/Hydraulic Safety

None appear warranted at this time; however, a dam break analysis should be performed as part of an emergency action plan.

1.2.3 Recommendations Regarding the Supporting Technical Documentation

None appear warranted at this time.

1.2.4 Recommendations Regarding the Description of the Management Unit(s)

None appear warranted at this time.

1.2.5 Recommendations Regarding the Field Observations

None appear warranted at this time.

1.2.6 Recommendations Regarding the Maintenance and Methods of Operation

It is recommended that precaution be taken to not mow the embankment when wet or to take necessary measures to not create ruts perpendicular to the embankment slope. It is recommended that all under drain outlets be protected with small-animal guards. Grass needs to be established in bare areas where soil is visible.

1.2.7 Recommendations Regarding the Surveillance and Monitoring Program

Continue current program.

1.2.8 Recommendations Regarding Continued Safe and Reliable Operation

Perform dam break analysis and develop an emergency action plan in the event of dam failure.

1.3 PARTICIPANTS AND ACKNOWLEDGEMENT

1.3.1 List of Participants

Javier Garcia – Environmental Protection Agency (EPA)
Autumn Hoban-Romanski – North Carolina Department of Natural Resources (NCDENR)
Dulcie Phillips – Progress Energy Carolinas (PEC)
Bill Forster - Progress Energy Carolinas (PEC)
Justin Story – Dewberry & Davis, Inc. (DDI)
Frederic Shmurak – Dewberry & Davis, Inc. (DDI)

1.3.2 Acknowledgement and Signature

We acknowledge that the management unit referenced herein has been assessed on June 3, 2009.

Frederic M. Shmurak, PE (NC # 027071)	Justin Story, Civil Engineer

2.0 DESCRIPTION OF THE COAL COMBUSTION WASTE MANAGEMENT UNIT(S)

2.1 LOCATION

The Mayo Electric Generating Plant is located approximately 10 miles northeast of Roxboro, North Carolina in Person County. The ash pond dam is approximately 1,000 feet south of the North Carolina-Virginia state line. See Appendix A – Doc 10.

2.2 SIZE AND HAZARD CLASSIFICATION

Based on data provided by Progress Energy Carolinas, Inc. (PEC), the ash pond dam is approximately 90 feet height, 2,300 feet long and 400 feet wide at the base (See Table 2.4.1). The pond storage capacity is 4,100 acre-feet and the surface area is 140 acres. It is estimated that the pond storage capacity when the material is at the top of the dam is approximately 6,000 acre-feet. The classification for size, based on the height of the dam and storage capacity, is Intermediate in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria.

This dam has been established Significant as a Hazard Classification. Per the Federal Guidelines for Dam Safety dated April 2004, Dams assigned the significant hazard potential classification are those dams where failure or mis-operation results in no probable loss of human life, but can cause economic loss, environmental damage, disruption of lifeline facilities, or can impact other concerns.

2.3 AMOUNT AND TYPE OF RESIDUALS CURRENTLY CONTAINED IN THE UNIT(S) AND MAXIMUM CAPACITY

Per Progress Energy, this ash pond contains fly ash, bottom ash, boiler slag, categorical low volume wastewater, coal pile runoff, ash sluice water/cooling tower blowdown and storm water. It was also noted that flue gas emission control residuals will be introduced to the lower area of the pond in 2009. The surface area for the pond is approximately 140 acres. The total storage capacity is approximately 4,100 acre-feet. The volume of the material currently stored is approximately 2,435 acre-feet based on an estimate in July 2007 made by PEC.

Table 2.3: Amount of Residuals and Maximum Capacity of Unit

	Mayo Ash Pond Dam
Surface Area (acre)	140
Current Storage Capacity (acre-feet)	4,100
Total Storage Capacity (acre-feet)	6,000
Crest Elevation (feet)	490
Normal Pond Level (feet)	480

Data taken from PEC Questionnaire, See Appendix A-Doc 04.

2.4 PRINCIPAL PROJECT STRUCTURES

2.4.1 Earth Embankment Dam

The dam embankment is a composite of compacted random earth fill and rock fill with impervious membrane placed at the upstream face, a random fill toe, a chimney drain system and a sand filter toe drain to control seepage. The embankment upstream and downstream slopes are 2.5(H):1(V); please refer to Appendix A – Doc 02 for dam geometry, plan, profile and sections.

Table 2.4.1: Summary of Dam Dimensions and Size

	Mayo Ash Pond Dam
Dam Height	90'
Crest Width	20'
Length	2,300'
Side Slopes (upstream)	2.5:1
Side Slopes (downstream)	2.5:1
Hazard Classification	Significant

Data taken from PEC Questionnaire, See Appendix A-Doc 04.

2.4.2 Outlet Structures

The outlet works consist of a concrete broad crested weir, located within a stilling pond, in the eastern portion of the reservoir. Water is conveyed over the weir through an open channel and is discharged into the Mayo Reservoir. The stilling pond is formed by an earthen dike with a CMP riser and skimmer within the reservoir. Details of the outlet works were not provided, and the structure could not be accessed for measurement during the field reconnaissance.

2.5 CRITICAL INFRASTRUCTURE WITHIN FIVE MILES DOWN GRADIENT

No critical infrastructure within five miles down gradient was observed using Google Earth Images dated 2009. The land use downstream is primarily agriculture and farm land. There is one gravel secondary road immediately downstream of the dam and few unimproved road crossings downstream. See Appendix A – Doc 10.

3.0 SUMMARY OF RELEVANT REPORTS, PERMITS AND INCIDENTS

3.1 SUMMARY OF REPORTS ON THE SAFETY OF THE MANAGEMENT UNIT(S)

PEC provided the 5-Year Independent Consultant Inspection Report, by Law Engineering & Environmental Services, dated December 22, 1999 and by MACTEC, dated June 9, 2004 for the Ash Pond facility. The independent inspection is performed at 5-year intervals as required by the North Carolina Utilities Commission (NCUC) and not licensed by the Federal Energy Regulatory Commission. The reports concluded that the Ash Pond facility had no significant deficiencies or indications of potential significant deficiencies which would endanger the safety of the structures and that no serious deficiencies were observed in maintenance or methods of operation, quality and adequacy of surveillance.

3.2 SUMMARY OF LOCAL, STATE AND FEDERAL ENVIRONMENTAL PERMITS

The facility is under regulation by the NCUC. No local, state or federal permits have been provided for this dam.

3.3 SUMMARY OF SPILL/RELEASE INCIDENTS (IF ANY)

No spills or releases from the Ash Pond facility have been noted by PEC.

4.0 SUMMARY OF HISTORY OF CONSTRUCTION AND OPERATION

4.1 SUMMARY OF CONSTRUCTION HISTORY

4.1.1 Original Construction

Construction began for the ash pond dam in August of 1981 and was completed in October of 1982. The Mason C. Day Company was the contractor and S&ME performed the testing and inspection services. The ash pond was designed by Carolina Power & Light and Mr. William Wells, P.E.

4.1.2 Significant Changes/Modifications in Design since Original Construction

The original design has not been modified.

4.1.3 Significant Repairs/Rehabilitation since Original Construction

No information was provided regarding repairs or rehabilitation. Rip rap was placed on the bottom third of the downstream slope in 1984 to prevent erosion. Soil stabilization fabric and seeding were placed on the upper two thirds of the downstream slope. The V-notch weirs at the internal drains were removed in 1993 and a graduated cylinder or bucket and stopwatch method of measuring seepage was substituted for weir plate measurement.

4.2 SUMMARY OF OPERATIONAL HISTORY

4.2.1 Original Operational Procedures

The dam was designed and operated for reservoir sedimentation and sediment storage; specifically, fly ash, bottom ash, boiler slag and flue emission control residuals. Coal combustion process waste water and stormwater runoff from the facility are discharged into the reservoir, inflow water is treated through gravity settling and deposition, and treated process water and stormwater runoff are discharged through an unregulated overflow outlet structure.

4.2.2 Significant Changes in Operational Procedures since Original Startup

No operational procedures have changed.

4.2.3 Current Operational Procedures

Original operational procedures are in effect.

4.2.4 Other Notable Events since Original Startup

No additional information was provided.

5.0 FIELD OBSERVATIONS

5.1 PROJECT OVERVIEW AND SIGNIFICANT FINDINGS

Dewberry & Davis, Inc. performed a site visit on Friday, June 3rd, 2009. The site visit began at 10:00 AM. Weather was a sunny, hot, clear day. The embankment had just recently been mowed as evidenced by widespread deposits of grass on the embankment. The overall assessment of the dam was that it was in satisfactory condition and no significant findings were noted. Please refer to photographs in Appendix B.

5.2 EARTH EMBANKMENT DAM

4.2.1 Crest

The crest had no signs of any depressions, tension cracks or other indications of settlement or shear failure, and appeared to be in satisfactory condition.

4.2.2 Upstream Slope

The upstream slope is protected with rip rap and some vegetation. Scarps, sloughs, depressions or other indications of slope instability or signs of erosion were not observed.

4.2.3 Downstream Slope and Toe

The downstream slope was grassed and no deep rooted vegetation was noted. Approximately the bottom one-third of the embankment was covered with rip rap in 1984 because a significant amount of erosion had been occurring. There were isolated areas of minor rutting, which likely resulted from the wheeled tractor that mowed the grass. Scarps, sloughs, depressions or other indications of slope instability or signs of erosion or uncontrolled seepage were not observed.

4.2.4 Abutments and Groin Areas

Erosion or uncontrolled seepage was not observed along either groin. The abutments and groin areas appeared to be in excellent condition.

5.3 OUTLET STRUCTURES

5.3.1 Overflow Structure

The primary overflow structure was observed to be working properly, discharging flow from the pond, and visually appeared to be in satisfactory condition.

5.3.2 Outlet Conduit

There is no outlet conduit present.

5.3.3 Emergency Spillway (If Present)

No emergency spillway is present.

5.3.4 Low Level Outlet

No low level outlet is present.

6.0 HYDROLOGIC/HYDRAULIC SAFETY

6.1 SUPPORTING TECHNICAL DOCUMENTATION

6.1.1 Floods of Record

Progress Energy stated the highest pond elevation they have observed was approximately 1.7 feet above the designed pond elevation of 480 feet during Hurricane Fran on September 5, 1996. Local rain gauge data reportedly recorded 6" of rainfall in 24 hours. This rain event would have left approximately 8.5 feet of freeboard based on the provided top of dam elevation at 490 feet. See Independent Consultant Inspection dated December 1999 under Appendix A – Doc 01 (page 17).

6.1.2 Inflow Design Flood

The ash pond was designed to store the maximum probable precipitation (PMP). The PMP was determined using HMR-51 and is approximately 39.5 inches of rainfall in a 24 hour period. See Independent Consultant Inspection dated December 1999 under Appendix A – Doc 01 (page 20). The recommended spillway design flood for a high hazard intermediate sized structure, in accordance with the USACE Recommended Guidelines for Safety Inspection of Dams ER 1110-2-106 criteria, is the Probable Maximum Flood (PMF); therefore the facility is in compliance with this standard.

6.1.3 Spillway Rating

No spillway rating was provided.

6.1.4 Downstream Flood Analysis

No downstream flood analysis was provided.

6.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Supporting technical documentation is adequate.

6.3 ASSESSMENT OF HYDROLOGIC/HYDRAULIC SAFETY

Based on the Independent Consultant Inspection dated December 1999 under Appendix A – Doc 01 (page 20), a maximum rise for the water was 7.2 feet above the normal pond elevation of 480 feet for the design storm. The freeboard elevation is approximately 2.8 feet when water is at the design storm. Adequate freeboard appears to exist in order to safely store and pass the design flood.

7.0 STRUCTURAL STABILITY

7.1 SUPPORTING TECHNICAL DOCUMENTATION

7.1.1 Stability Analyses and Load Cases Analyzed

Static and seismic loading were analyzed. See Table 7.1.4 for results.

7.1.2 Design Properties and Parameters of Materials

See Table 7.1.2

Table 7.1.2: Design Properties and Parameters of Materials

Borrow Material Type	Cohesion C (psf)	Friction Angle Φ
Impervious	0	24
Random	0	30

Data taken from Independent Consultant Inspection Report provided by Progress Energy dated December 1999, see Appendix A – Doc 01 (Page 19 & Exhibit 28).

7.1.3 Uplift and/or Phreatic Surface Assumptions

No uplift calculations were provided. Based on the stability model (Appendix A – Doc 01, Exhibit 29), the assumed phreatic surface is consistent with the piezometer readings. Piezometers 1A, 2A, 3A and 4A were designed to remain dry when the sand filter and toe drain are working properly which remains consistent with the reports provided by Progress Energy.

7.1.4 Factors of Safety and Base Stresses

See Table 7.1.4

Table 7.1.4: Factors of Safety

	Mayo Ash Pond Dam
Static Loading	1.52
Seismic Loading (a=0.1g)	1.12

Data taken from Independent Consultant Inspection provided by Progress Energy dated December 1999, see Appendix A – Doc 01 (Page 19).

7.1.5 Liquefaction Potential

No liquefaction potential data was submitted. Foundation soil conditions do not appear susceptible to liquefaction.

7.1.6 Critical Geological Conditions and Seismicity

No critical geological conditions are present. The site lies in a relatively inactive seismic area; however, based on USGS Seismic-Hazard Maps for the Conterminous United States, dated 2005, the facility is located in an area anticipated to experience a 0.08g acceleration with a 2-percent probability of exceedance in 50-years. A design acceleration of 0.1g was used for this site which meets the standards for this region (Appendix A – Doc 01, Page 4). Additional geological conditions are included in Appendix A – Doc 08.

7.2 ADEQUACY OF SUPPORTING TECHNICAL DOCUMENTATION

Structural stability documentation is adequate.

7.3 ASSESSMENT OF STRUCTURAL STABILITY

Based on the previous assessments/inspections provided by Law Engineering & Environmental Services, MACTEC and Progress Energy, our assessment seemed consistent with historical observations. The internal drains are flowing clear and at a consistent rate which is a good indication internal soil piping is not occurring. There were no indications of scarps, sloughs, depressions or bulging anywhere along the dam. Boils, sinks or uncontrolled seepage was not observed along the slopes, groins or toe. The crest appeared free of depressions. The computed factors of safety comply with accepted criteria. Overall, the structural stability of the embankment appears to be satisfactory.

8.0 ADEQUACY OF MAINTENANCE AND METHODS OF OPERATION

8.1 OPERATIONAL PROCEDURES

Operational procedures are adequate. The facility is operated for reservoir sedimentation and sediment storage; specifically, fly ash, bottom ash, boiler slag and flue emission control residuals. Coal combustion process waste water and stormwater runoff from the facility are discharged into the reservoir, inflow water is treated through gravity settling and deposition, and treated process water and stormwater runoff is discharged through an unregulated overflow outlet structure.

8.2 MAINTENANCE OF THE DAM AND PROJECT FACILITIES

Maintenance procedures are adequate. Grassed areas are routinely mowed and deep rooted vegetation is removed from the rip-rap slopes. Spillways and outlets are maintained and debris is removed as needed.

8.3 ASSESSMENT OF MAINTENANCE AND METHODS OF OPERATION

8.3.1 Adequacy of Operational Procedures

Operation procedures are adequate.

8.3.2 Adequacy of Maintenance

The maintenance program is adequate. It is recommended that precaution be taken to not mow the embankment when wet or to take necessary measures to not create ruts perpendicular to the embankment slope. It was recommended that all under drain outlets be protected with small-animal guards. Grass needs to be established in bare areas where soil is visible.

9.0 ADEQUACY OF SURVEILLANCE AND MONITORING PROGRAM

9.1 SURVEILLANCE PROCEDURES

Per Progress Energy, the surveillance program is as follows:

Semi-Annual Inspections:
"Semi-annual inspections that include visual inspections and data gathering to detect any problems at an early stage of development are conducted by plant personnel." See Appendix A – Doc - 05 for copy of the February 12, 2009 inspection report.

Annual Inspections:
"Annual inspections are conducted by a third-party professional engineering contractor. The engineering firms that conduct the inspections have expertise in geotechnical and civil engineering." See Appendix A – Doc - 06 for copy of the March 6, 2008 inspection report.

Five-year Inspections:
"Comprehensive five-year inspections are conducted by a third-party professional engineer contractor. The engineering firms that conduct the inspection have expertise in geotechnical and civil engineering." See Appendix A – Doc 07 for copy of the June 9, 2004 inspection report.

9.2 INSTRUMENTATION MONITORING

9.2.1 Instrumentation Plan

A seepage collector box is located at the toe of the slope at the outlets of the internal drains. Points of seepage flow are measured or estimated. Internal drain outlets are visually inspected for proper function. A graduated beaker and stop watch are used to determine flowrate. Four pairs of piezometers are located within the downstream slope. For piezometer readings, a water level indicator probe is used, which is lowered within the monitoring well until water is reached, and the distance is recorded. Please refer to Appendix A, Doc 02 Exhibit 30 Asheville Mayo Electric Generating Plant 5 Year Dam Safety Inspection – 1989 Ash Pond Dam - Piezometers for locations of the piezometers.

9.2.2 Instrumentation Monitoring Results

Data is recorded on a standard inspection report for Progress Energy. A copy is given to the manager of the Mayo Electric Generating Plant, and one additional copy is maintained in Progress Energy's files. Please refer to Appendix A, for sample reports.

9.2.3 Evaluation

The historical data indicates that the embankment dam is performing adequately.

9.3 ASSESSMENT OF SURVEILLANCE AND MONITORING PROGRAM

9.3.1 Adequacy of Inspection Program

Inspection program is adequate.

9.3.2 Adequacy Instrumentation Monitoring Program

Instrumentation monitoring program is adequate.